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MONITOR WEATHER CONDITIONS FOR CLOUD SEEDING CONTROL

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FOR CLOUD SEEDING CONTROL Progress
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Type I Progress Report for Period from January 1, 1974 - February 28, 1974

Prepared for:

Goddard Space Flight Center
Greenbelt, MD 20771

Type I Progress Report
ERTS-A

- a. Title: Monitor Weather Conditions for Cloud Seeding Control
ERTS-A Proposal No.: 642
- b. GSFC ID No. of P.I.: IN 024
- c. For the period from January 1, 1974 to February 28, 1974: There were no problems impeding the progress of this investigation.
- d. Progress in reporting period:

Progress during the reporting period proceeded along two separate lines: Routine operation of the ERTS network, including servicing and maintenance, and special work on data transmission characteristics of the individual DCP's, computer program development, and exposure of possible users to the ERTS data relay concepts.

I. Routine ERTS Operations

Routine cloud seeding operations in The Colorado River Basin Pilot Project continued as the 1973-74 experimental season reached the mid-way point. The cloud seeding contractor continued to make routine use of ERTS data in the control of cloud seeding operations and in near-real time monitoring of weather parameters at remote sites in the cloud seeding target area during non-seeded days.

Some minor maintenance problems were encountered at two of the ERTS DCP's during the reporting period. The largest part of the field work by the contractor, however, continued to be in servicing the ERTS precipitation sensors (Belfort recording raingages). Precipitation gage servicing was accomplished by contractor personnel from their Durango office. Unusually heavy snowfalls occurred during the last few days of December and first few days of January and some sensor malfunctions occurred, necessitating the scheduling of servicing trips to nearly all of the sites. Servicing trips to the ERTS sites were somewhat delayed since the highest priority job for contractor personnel is the servicing and maintenance of the primary precipitation sensor network used in collecting data for use in statistical tests of the effect of the seeding reagent. Following is a description of maintenance and servicing requirements for each of the ERTS sites.

A. Palisade Lake

The Palisade lake DCP continued to function well throughout the reporting period. Problems were encountered, however, with the recording precipitation gage that is connected to channel 3.

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Heavy snowfalls in early January caused snow to bridge inside the gage and resulted in intermittent problem data from January 3 through January 24. Additional heavy snowfalls caused the gage to reach full capacity (10 inches water equivalent) on January 27. A servicing trip was immediately scheduled and the site was visited by technicians in an oversnow vehicle on February 7. The storage reservoir was emptied and recharged with 2 inches of an anti-freeze and evaporation retardant solution. The DCP was carefully checked over since it was unclear from time-share terminal diagnostics whether the precipitation storage gage had reached full capacity or whether there had been a channel failure in the DCP. Data from this channel cleared up after the instrument was serviced, indicating that there was no problem with the DCP. A subsequent trip to this site on February 18 enabled field technicians to check over all DCP circuits with the Field Test Set. A telephone conference between field personnel and the contractor's electronics personnel verified that the DCP was working perfectly. The Palisade Lake site required considerable effort on the part of the field crews during the reporting period since the trip to Palisade Lake involves a 15 mile round trip by oversnow vehicle.

B. Wolf Creek North

No maintenance or servicing trips were required to the Wolf Creek North ERTS site during this reporting period.

C. Castle Creek

A trip to service the Castle Creek recording precipitation gage was scheduled for February 6. No maintenance was required in this reporting period.

D. Runlett Park

The battery voltage at the Runlett Park DCP dropped suddenly on January 18 from 12.8 volts to 9.8 volts and then gradually declined to 0.7 volts. The transmitter continued to send messages through the satellite despite the very low voltage but the data was not useable. A new battery and voltage regulator were installed on February 10 and all channels once again began to send out good data - except for channel 3. The wind speed data coming over channel 3 did not appear to be correct and further monitoring of the channel indicated that the DCP was failing to handle data properly on that channel. An electronics technician was flown to the site by helicopter on March 5, and tests indicated that the input FET for channel 3 had evidently opened up. The wind speed input was then transferred to channel 5, and channel 3 was shorted to ground. The contractor then notified the Bureau of changes in the computer programs that would be necessitated because of this action.

Field technicians have suggested a cause for the failure of the battery at this site and the consequent failure of one of the data channels. The ERTS battery at the Runlett Park site receives a much larger current drain than batteries at other ERTS sites since a separate ground telemetry transmitter is co-located with the ERTS site and draws current from the ERTS battery to activate some sensors which are used by both telemetry systems. Consequently, a solar panel had been installed near the ERTS installation to recharge the ERTS batteries. Technicians found that the solar panel, which was mounted in a near-horizontal position, was covered by 6-8 inches of snow when they arrived at the site. The battery failure was probably due to failure of the solar panel to recharge the battery and could have also been aggravated by an unusually frequent polling sequence of the ground telemetry site. Precipitation records indicate that the sudden drop in battery voltage followed a snowstorm which dumped 2-3 inches of new snow at the Runlett Park site.

The fresh battery installed at Runlett Park is expected to alleviate the problem in the future since it will have the capacity to power all the sensors over a period of time sufficient for new snow to melt or blow off the solar panel. The fact that the problem did occur suggests that batteries at this site need to be changed more often in the future.

E. Muleshoe

The Muleshoe ERTS site required no servicing but did require some minor maintenance. A maintenance trip to the Muleshoe ground telemetry station, which is located next to the ERTS DCP, was accomplished on January 14. Field maintenance personnel apparently jarred loose a wire going from the wind speed sensor to the ERTS package, resulting in failure of the channel containing wind speed data. The wire was reconnected on February 28 during a routinely scheduled helicopter visit to this remote site and the problem was alleviated. A special helicopter trip to this site was judged to be unnecessary since only one data channel was affected and backup wind speed data was available from the ground telemetry site.

F. Wolf Creek Pass

No maintenance was necessary at the Wolf Creek Pass ERTS site during the reporting period. The precipitation gage was serviced on January 11 after several heavy snowstorms and again on March 10.

G. Lime Mesa

No maintenance was required during the reporting period. The precipitation gage at Lime Mesa was serviced on January 12 and again on February 10. Both servicing trips were accomplished by helicopter.

II. Special ERTS - Related Work

A. Computer Program Development

Computer programs have previously been developed by Bureau of Reclamation personnel to translate data received from Goddard into an engineering units listing. These listings are then available via remote time-sharing terminals from the CSS time-sharing computer in Denver. No new programs were required during this reporting period, although some existing programs had to be modified with new platform assignment numbers and new sensor calibration curves. Sensor calibration curves were obtained by WSSI, the primary contractor, as instruments were set up in the field and as previously installed instruments were recalibrated. The sensor calibration curves were then analyzed using a linear regression analysis technique and the slopes and intercepts of the least square lines were entered into the computer programs.

During this reporting period three stations required new entries into the computer programs:

- 1) Calibration curves were entered for the newly installed Castle Creek site.
- 2) New calibration curves were entered for sensor recalibrations at the Wolf Creek Pass site, and
- 3) New calibrations were entered for some channels at the Muleshoe site to accomplish a simple change in display of data units.

B. ERTS DCS Exposure

Special efforts were made during this reporting period to give maximum exposure of the ERTS data relay concepts to potential users. Western Scientific Services, Inc. personnel prepared a short oral presentation for the annual meeting of the Weather Modification Association in Huntington Beach, California in March.

ERTS data has also been sent to the Soil Conservation Service for their use in comparing ERTS data to on-site snow pillow data from their Palisade Lakes site.

C. Satellite Visibility Statistics

Study is continuing on the applicability of using simple surveying measurements at proposed ERTS sites to forecast the frequency of data relay to ground receiving sites via ERTS satellite. Data relay statistics are also being calculated for the present ERTS locations in the Colorado River Basin Pilot Project. This work will be reported in the next bi-monthly report.

III. Progress Planned for Next Reporting Period

A. An analysis of satellite visibility statistics will be completed for each of the winter sites. Preliminary conclusions will be drawn on the applicability of using simple surveying measurements at proposed sites to forecast the frequency of data relay to ground receiving sites via ERTS satellite.

e. Results to date are:

1. The near real-time DCS platform data transfer to time-share computer is a working reality. Seven stations are now being automatically monitored and displayed with a system delay of 3 to 8 hours from time of data transmission to time of data accessibility on the computer.
2. The DCS platform system has proven itself a valuable tool for near real-time monitoring of mountain precipitation. Data are being used operationally by the Bureau's cloud seeding contractor for control of cloud seeding operations and for verification of weather forecasts.
3. The DCS platforms, as deployed in this investigation, have proven themselves to be reliable weather resistant systems for winter mountain environments in the southern Colorado mountains.

f. Publications:

Olin Foehner, Monitor Weather Conditions for Cloud Seeding Control, ERTS Investigation Number 642. Presentation of paper to Discipline Panel Review, ERTS Investigations, Goddard Space Flight Center, Greenbelt, Maryland. October 24, 1973.

C.D. Whiteman, Satellite Data Collection Systems. Report to Bureau of Reclamation by Western Scientific Services, Inc. October 10, 1973.

g. Recommendations: None

h. Changes in standing order forms:

12-26-73 addition

i. ERTS image descriptor forms: N/A

j. Changes in data request forms:

1-11-74 addition

k. Seven DCS platforms are in place and operational. One spare platform acts as a backup to the other units.